A Strategic Plan for Change Inventory and Monitoring Pilot Projects

Prepared for
Jon Vivian, *RPF*
Resources Inventory Branch
Ministry of Forests
P.O. Box 9516 Stn Prov Govt
Victoria, BC V8W 9C2

Project: MFI-401-055

March 31, 2000

J.S. Thrower & Associates Ltd. *Consulting Foresters*
Vancouver – Kamloops BC

106-06696/

Executive Summary

This document outlines a strategic sampling plan for the Ministry of Forests (MOF) change inventory and monitoring pilot projects. The objectives of the pilot projects are to:

1. Install a sample of change inventory or change monitoring plots in two large management units in the province.
2. Demonstrate change estimation and monitoring methods using simulated change data based on projections of actual initial measurements.
3. Study the efficiency (time) of establishing and relocating change inventory or change monitoring plots.

Two pilot project sites have been selected: Weyerhaeuser Canada Ltd. TFL 35 and Babine Forest Products Ltd. Enhanced Forest Management Pilot Project (EFMPP) area. The next step is to prepare detailed project implementation plans (PIPs) for each site. These PIPs should describe the target population, the sample size and locations, the attributes to be measured, and the schedules and costs. They should also outline roles and responsibilities for the preparation of sample packages, fieldwork, quality assurance, and data compilation and analysis.

Table of Contents

1. INTRODUCTION 1
1.1 Background 1
1.2 Document Objectives 1
1.3 Terms of Reference 1
2. STRATEGIC PLAN 2
2.1 Goal 2
2.2 Objectives 2
2.3 Desired Products 2
2.4 Pilot Sites 2
2.5 Methodology 3
2.6 Analyses 4
3. PROJECT IMPLEMENTATION 4
4. APPENDIX I – PILOT PROJECT AREAS 6
4.1 Weyerhaeuser's TFL 35 6
4.2 Babine's EFMPP 7
5. APPENDIX IV – DEFINITIONS 9

List of Tables

Table 1. Area (ha) summary of TFL 35. 6
Table 2. Area (ha) summary of Babine EFMPP. 8

List of Figures

Figure 1. Pilot projects implementation schedule in 2000. 5
Figure 2. Location of TFL 35 near Kamloops, BC. 6
Figure 3. Distribution of BGC subzones in TFL 35. 6
Figure 4. Location of Babine's EFMPP. 7
Figure 5. Distribution of BGC subzones in Babine's EFMPP. 8

1. INTRODUCTION

1.1 BACKGROUND

In 1998, the Ministry of Forests (MOF) awarded a two-year contract to J.S. Thrower & Associates Ltd. (JST) to develop growth & yield (G&Y) monitoring protocols. The second year (2000) of this contract (Schedule A) involves three tasks to be completed:

A. *Conceptual sampling methods* – Develop and recommend conceptual sampling methods to estimate change[1] at the provincial level and monitor estimates of change at the management unit level. We completed this task in December 1999 with submission of the final report.[2]

B. *Detailed procedures* – Develop estimators, procedures, standards, and field protocols based on approved conceptual methods from Task A. Demonstrate the use and application of the recommended methods.

C. *Pilot strategic sampling plan* – Complete a strategic sampling plan for a pilot study of the change inventory design at the provincial level, including objectives, desired products, and a general strategic direction for implementing the pilot project.

This report addresses Task C. The deliverables for Task B, including statistical estimation procedures and detailed field procedures at the provincial and management unit level, are reported separately.

1.2 DOCUMENT OBJECTIVES

This document outlines the strategic plan for pilot projects to test proposed change inventory and monitoring methods. These methods are described in the reports *Conceptual sampling methods for change inventory and monitoring of vegetation resources version* 2.0 and *Vegetation Resources Inventory Change Measurement: Preliminary Field Procedures*[3].

1.3 TERMS OF REFERENCE

This report was prepared under contract for the MOF Resources Inventory Branch (RIB) by A.Y. Omule, *PhD, RPF* of JST. Other team members included Ian Cameron, *MSc, RPF*, Eleanor McWilliams, *MSc, RPF*, Guillaume Thérien, *PhD*, and Jim Thrower, *PhD, RPF*.

---

[1] Definition of change and other terms are provided in Appendix II.

[2] J.S. Thrower and Associates Ltd. 1999. *Conceptual sampling methods for change inventory and monitoring of vegetation resources version 2.0.* Unpublished report. December 13, 1999.

[3] Ministry of Forests. 2000. *Vegetation Resources Inventory Change Measurement: Preliminary Field Procedures version 1.0.* Unpublished Report. March,2000.

2. STRATEGIC PLAN

2.1 GOAL

The main goal of the proposed pilot projects is to:

> *Test the operational implementation of the provincial-level change inventory system and the management-unit change monitoring system.*

The purposes of the test are to:

1. Determine how well the systems components work (e.g. planning, plot establishment, and data analysis).
2. Identify possible shortcomings.
3. Make any necessary improvements to the proposed systems.

2.2 OBJECTIVES

The specific objectives of the pilot projects are to:

1. Install a sample of change inventory and monitoring plots in two management units in the province.
2. Demonstrate change estimation and monitoring methods using simulated change data, which is based on projections of actual initial measurements.
3. Study the efficiency (time) of establishing and relocating the inventory and monitoring plots.

2.3 DESIRED PRODUCTS

The expected deliverables from the pilot projects are:

1. A sample of change inventory or change monitoring plots in two management units.
2. Results including raw data, summaries, and analyses.
3. Studies of each function over time (resource measurement, stem mapping, plot monumentation, and plot re-location)
4. Detailed recommendations for change inventory and monitoring field procedures and analysis methods.

2.4 PILOT SITES

The MOF recommended the selection of two pilot project areas. Based on stakeholder interest and funding considerations, the pilot project areas will be located in Weyerhaeuser Canada Ltd. (WeyCan) Tree Farm Licence (TFL) 35 and the Babine Forest Products Ltd. (Babine) Enhanced Forest Management Pilot Project (EFMPP) area (Appendix I).

A detailed project implementation plan (PIP) should be prepared for each site. The PIPs should include definition of:

- target population,
- sample size and locations,
- attributes to be measured,
- roles and responsibilities for preparation of sample packages, fieldwork, quality assurance, data compilation, and data analysis, and
- schedules and costs.

2.5 METHODOLOGY

2.5.1 Plot Establishment Options

Two options are proposed for establishing plots to estimate change in a pilot site:

1. Measure a subset of existing or planned VRI plots.
2. Establish a set of plots independent of the VRI.

The choice of option should depend on specific pilot site considerations. For example, the first option may be preferred if a VRI already exists and the focus is to check the predicted change (i.e., growth) in timber volume over time. However, this option may not address issues requiring an independent sample of the landbase or the need to monitor non-timber attributes.

2.5.2 Sample Size

A minimum sample size of 30 plots is suggested per pilot site. However, sample size should be determined for each pilot site after considering the attributes of interest, natural variability, desired level of precision in estimates of change, and the level of confidence in existing predictions. Larger samples will be required in most cases to permit post-stratification of the data.

2.5.3 Sample Selection

Plots can be selected with equal probability based on simple random or systematic sampling. It is preferable not to pre-stratify the target population, but post-stratification may be done to examine specific portions of the population. Systematic sampling can be done from an ordered list (with random start) or by using a systematic grid over the pilot site.

2.5.4 Plot Measurement

Plots should be established and measured in the initial target population over as short a time frame as possible (preferably within 1 year). All plots should be re-measured on a consistent cycle (e.g., every five years) to provide a common time increment for change observations.

2.5.5 Field Procedures

Change measurement data definitions, standards, measurements, and field cards for the initial measurement and re-measurements will be based on the VRI ground sampling procedures manual (with some additions). The major additions include a fixed-area plot for large trees (⌑4.0 cm diameter at breast height) and polygon boundary mapping on the plot cards. The additions are described in the report *Vegetation Resources Inventory Change Measurement: Preliminary Field Procedures*. Modifications may be made to the field procedures, depending on the specific pilot site objectives. Plots will be permanent and inconspicuous, and subject to operational activities.

2.5.6 Time Studies

The following activities should be timed to study sampling efficiency:

1. Mapping the polygon boundaries,
2. Establishing a 10-m radius fixed-area plot,
3. Monumenting and re-locating the Integrated Plot Centre (IPC).

One or more crews should be studied per site, in at least 15 plot clusters. To approximate the time necessary to re-locate plots, a quality assurance (QA) check-cruiser should also be timed.

2.6 ANALYSES

To test the proposed change analysis methods, tree attributes for the first and second re-measurements (e.g. 5 and 10 years after establishment) should be simulated by projecting the measured values at time 0. The simulated data should then be analyzed, assuming provincial level sampling[4] and management unit sampling,[5] following the examples in the cited reports. Time study data should be summarized to calculate the average time to complete the specified tasks.

3. PROJECT IMPLEMENTATION

The change inventory and monitoring pilot projects may be implemented as follows (Figure 1):

---

[4] J.S. Thrower and Associates Ltd. 2000. *Statistical estimation methods for provincial change inventory version 2.0*. Unpublished report. March 31, 2000.

[5] J.S. Thrower and Associates Ltd. 2000. *Graphical & statistical analysis for monitoring estimates of change at the management-unit version 2.0*. Unpublished report. March 31, 2000.

1. Complete preparation of detailed field and analysis procedures for change inventory/monitoring (March, JST).
2. Prepare a strategic sampling plan, outlining pilot project goals, objectives and general implementation approach, as well as the description of the operational pilot sites (this report) (March, JST).
3. Prepare a detailed project implementation plan (PIP) for each selected pilot site (April, WeyCan and Babine).
4. Design field cards for time studies (April, MOF).
5. Select sample polygons and points (April, WeyCan and Babine).
6. Prepare sample packages (April, WeyCan and Babine).
7. Tender and select contract crews and an independent Check-Cruiser (May, WeyCan and Babine).
8. Locate and measure sample clusters, including time studies; enter and edit data (June-August, field contract crew).
9. Conduct quality assurance (June-August, Check-cruiser).
10. Validate and compile the data (September, MOF).
11. Analyze the data and report on the results of the pilots (October-November, MOF).
12. Make any revisions to the preliminary field procedures (December, MOF).

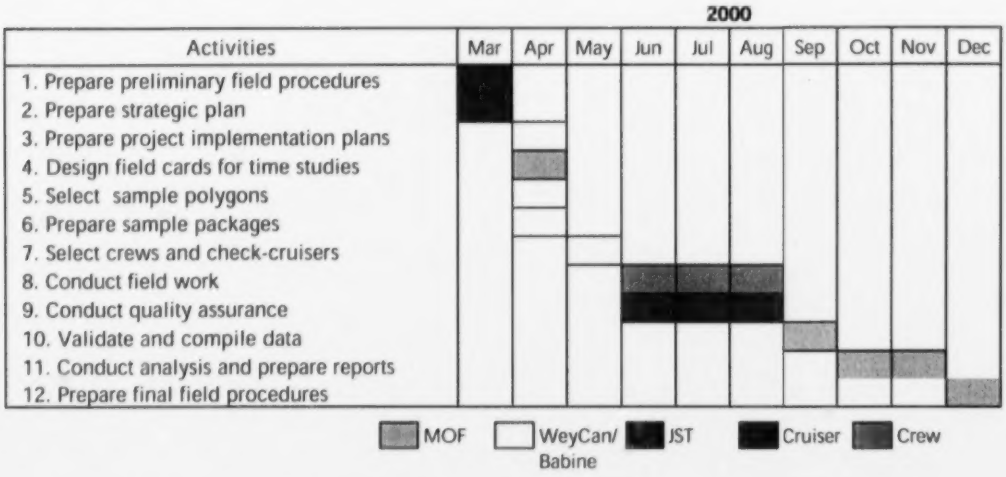

Figure 1. Pilot projects implementation schedule in 2000.

4. APPENDIX I – PILOT PROJECT AREAS

4.1 WEYERHAEUSER'S TFL 35

4.1.1 Landbase

TFL 35 is located about 25 km north of Kamloops, BC west of Highway 5 (Figure 2). The TFL is characterized by mid-elevation plateaus and gently rolling slopes, and covers several biogeoclimatic (BGC) subzones (Figure 3). The total TFL area is 36,445 ha, of which 97% (32,291 ha) form the productive forest land base (PFLB) (Table 1).

The primary commercial tree species on the TFL are lodgepole pine and spruce; secondary species are Douglas-fir and balsam with minor components of aspen and cedar.

Figure 2. Location of TFL 35 near Kamloops, BC.

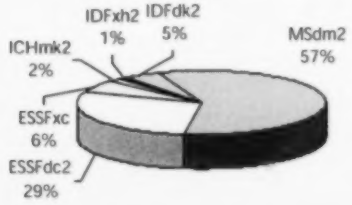

Figure 3. Distribution of BGC subzones in TFL 35.

Table 1. Area (ha) summary of TFL 35.

Entire TFL	*36,445*
Productive Forest	35,291
Non-Productive Forest	1,154
Swamp	523
Lake	361
Non-Productive	216
Open Range	41
Rock	13

4.1.2 G&Y Monitoring Program

WeyCan is interested in G&Y monitoring on TFL 35 and other areas in order to:

1. Support timber supply analysis and forest-level planning. WeyCan and the MOF require G&Y data to ensure that predicted yields used in timber supply analyses are reasonable.
2. Support market certification. Information to demonstrate sustainability and other forest management requirements to external agencies can be provided through G&Y monitoring programs.

WeyCan initiated a G&Y monitoring system in late 1994. However, its implementation was postponed while the MOF program was being developed. The MOF G&Y monitoring program is nearing completion and WeyCan is prepared to participate in its final development and testing.

4.2 BABINE'S EFMPP

4.2.1 Landbase

On July 10, 1997, Babine was awarded one of BC's EFMPPs. The objective of the EFMPP is to develop a forest management strategy to address timber supply challenges by offsetting downward pressure on timber supply, and to reflect changing public expectations for forest management.

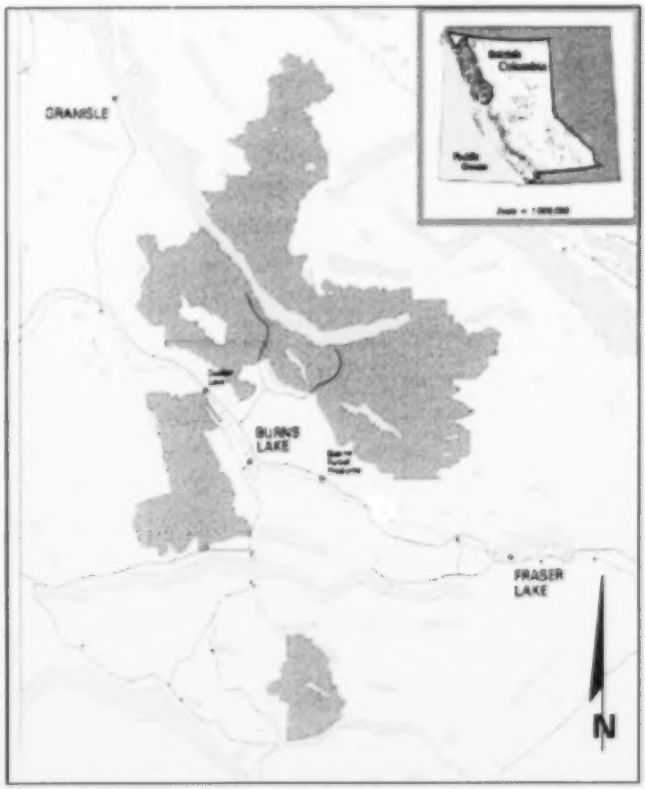

Figure 4. Location of Babine's EFMPP.

The EFMPP area is located within the Nechako Plateau in the northern portion of The Lakes TSA (Figure 4). The Lakes TSA is situated in the north-central interior of BC in the Prince Rupert Forest Region. The total project area is approximately 354,755 ha, of which approximately 85% (310,500 ha) make up the productive forest landbase (Table 2). This project area corresponds to the operating areas of Babine's two Forest Licence tenures (A16823 and A16825).

The forests in the EFMPP area are dominated by lodgepole pine (60%), spruce (21%), sub-alpine fir (11%), and other species (mostly aspen) (8%). The area contains about five BGC subzone variants (Figure 5).

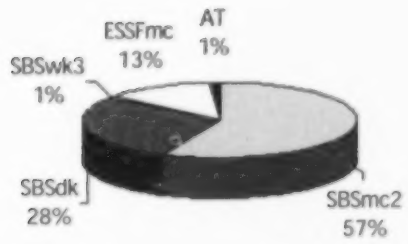

Figure 5. Distribution of BGC subzones in Babine's EFMPP.

Table 2. Area (ha) summary of Babine EFMPP.[6]

Entire EFMPP	*354,755*
Productive Forest	310,529
Non-Productive Forest	5,774
Non-Forest	35,873
Alpine	1,587
Rock	653
Meadow	254
Urban	240
River	190
Swamp	5,971
Lake	23,972
Non-Productive	2,855
Open Range	133
Other	272
Other	2,579

4.2.2 G&Y Monitoring Program

G&Y monitoring is part of the Growth and Yield Program Activities of the EFMPP. Babine is interested in working with the MOF to test the monitoring protocols in northern BC. They plan to install approximately 30 monitoring plots in specific forest types in 2000/2001. This work may be integrated with the Phase II ground sampling.

[6] Source: Babine Forest Products EFMPP Pre-Inventory Analysis report.

5. APPENDIX II – DEFINITIONS

We define the following terms for this report:

Change is net change, which is survivor growth plus ingrowth less mortality.

Change inventory is the process of observing changes and trends over time in the level of the resource and change in land cover classification between two or more time points.

Change projection is the process of predicting the difference in future level or classification of the resource between two or more time points in a management unit.

Change monitoring is an independent check on the projected change or growth in a management unit.

Growth monitoring is the process of observing the growth of a forest and comparing this with the predicted growth of that forest. Growth monitoring is a specific type of *change monitoring*.

Yield audit is the process of observing the yield of a forest and comparing this with the predicted yield of that forest.